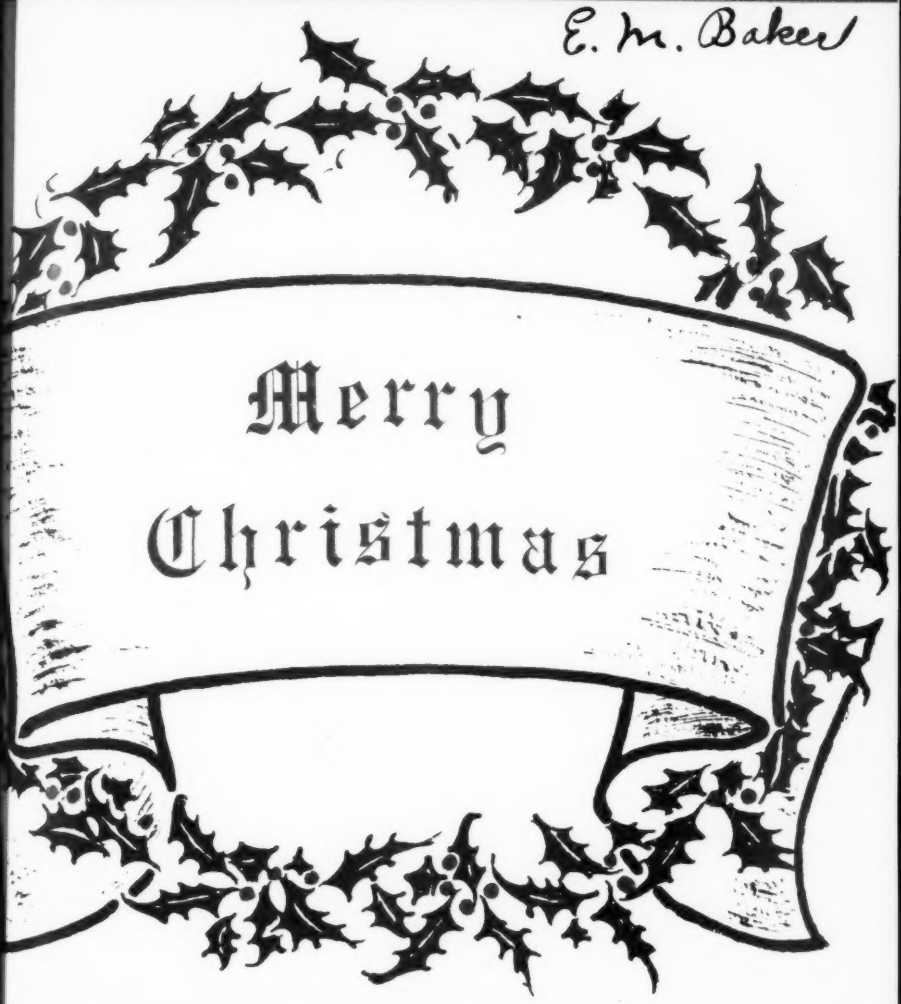
The Monthly Review
AMERICAN ELECTROPLATER'S SOCIETY

E. M. Baker



A SOCIETY FOR THE ADVANCEMENT OF THE SCIENCE OF ELECTROPLATING

DECEMBER—1942

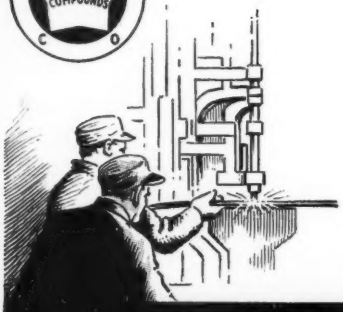
Cleaning and Etching Aluminum for SPOT-WELDING *by* Clepo

AIRPLANE BODY PARTS

DESIGNED for A.C. and HIGH-WAVE WELDING

RADIO PARTS

CLEPO — CLEANING COMPOUNDS



This new CLEPO process completely removes drawing compounds and annealing scale from aluminum parts to provide minimum welding resistance and maximum weld strength.

FREDERICK GUMM CHEMICAL COMPANY, Inc.
538-542 Forest St., Kearny, N. J.

The Monthly Review

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Editorial

Due to the fact that so many branches have had such unexpected interest, as indicated by the large attendance at their monthly meetings, we can logically say that electroplating and its related subjects are serving an invaluable purpose in the common war effort. This fact is already serving as an incentive for the various branch officers to promote large attendance at meetings, if for no other reason than to be of service, so that each manufacturer—large or small—may get every benefit from experts who are on the educational programs.

To those members of the A.E.S. who have not been attending the monthly meetings of their local branch, you have a delightful surprise coming, as well as an interesting program to enjoy. Many new faces are present, with an eager interest in the particular application which they are performing, which must necessarily be on materials for War.

This active interest at meetings means considerable to the average A.E.S. member. We are in an industry which finds numerous applications for War materials. A great number of these are new developments, but many are the continuation of deposition of various metals electrolytically—as done in peacetime. We can be certain that many of the new developments will find peace time use later.

This War is essentially a War of metals. Not merely a War of iron and steel, but a myriad of other metals which are called upon to serve an almost infinite number of requirements. As technical experts in the particular application of metals by the use of electrical energy—we are invaluable in expediting the War effort.

I am reminded of the fact that every era brings new developments or miracles. It takes the proper environment for miracle men to develop their abilities. A particular need is first created, and then the genius or developmental engineer attempts to apply all the tricks of science with which he is familiar—hoping to solve the problem. We certainly have before us a new set of conditions. What will be the outstanding new application for electroplating?

The attendance and interest at the various meetings to date, indicate that something of importance may be expected of the electroplaters.

M. R. CALDWELL.

Metal Cleaning in Wartime

By Henry Strow

MacDermid Inc., Waterbury, Conn.

TO most of us now, the things we did two and three years ago seem but as dreams. The war has so changed our way of thinking and methods of doing things that few things remain fixed in our every day work. As always, however, we carry into our war work the most improved methods used in peace times.

Metal cleaning follows this general pattern. Great changes have been made but in most cases these have been modifications or improvements in methods which were first used in peace time work. In order to better visualize the picture, we will try to survey the entire field of metal cleaning especially in regards to its application to electroplating and anodizing.

Electroplating work today is markedly different from a few years ago. Decorative nickel and chromium plating constituted probably the largest simple application of electroplating of a few years ago. Today there is no nickel plating for decorative purposes. The largest applications today lie in the rustproofing of metals. Owing to their special properties, cadmium and zinc are the most prominent metals and their consumption for this purpose will probably exceed that of nickel for decorative purposes a few years ago.

The lessons which we learned in cleaning steel prior to nickel plating are being used now for cadmium and zinc plating with much success. The outstanding development in the cleaning of steel for nickel plating was the introduction of the modern high current density, reverse current cleaners. The use of these cleaners made possible consistent operation of bright nickel in full automatics with a freedom from rejects never before experienced. The use of these high current density reverse current cleaners in war production prior to the application of plated coatings has brought numerous advantages. Freedom from rejects is extremely important especially where parts have had numerous operations on them before plating and a great danger exists that improper plating may ruin the part. Even where

stripping would not ruin the part the waste of the scarce metals which are stripped off is crime enough. Additional corrosion resistance may also be expected where modern cleaning methods are used. This is especially true where zinc is to be plated from a cyanide solution. Cadmium plating from a cyanide solution possesses so many advantages in plating characteristics over almost every other metal plate that it is often difficult to change from cadmium to zinc plating because of the increased cleanliness required. With war production perfect cleaning even before cadmium plate is essential because of the rigid specifications and the necessity of heating many parts after plating to remove hydrogen embrittlement. This imposes additional strains on the plate which tend to give blisters on parts which have been imperfectly cleaned. Now that we have discussed the reasons for better cleaning of plated work in war production, let us consider the recommended way of doing it.

If the parts are rusty or have large amounts of scale on them, the first operation should be the use of a pre-cleaner to remove oil and grease. The rust or scale is then pickled off in a suitable acid. For ordinary work a pickle containing 50% by volume of commercial muriatic acid is recommended. An inhibitor may be used in this acid although care should be used in the selection of the inhibitor that it does not adversely affect the plating.

After the work has been freed from rust and scale, it is ready for the final cleaning operation. This final operation is more than a mere cleaning and may properly be called a surface preparation. The first step is the use of a cleaner using the work as anode at a relatively high concentration generally from 12 to 16 ounces per gallon and a temperature of 200-210°F. Time necessary will vary from 30 seconds to several minutes. This cleaning removes the smut present on the surface of the work and also cleans the tiny cracks and crevices giving a clean metal surface. Following the cleaner, the parts are rinsed and then acid dipped, in a solution containing about 5-10% acid. This gives a final preparation of the surface without smut which might be present if a stronger acid were used. After the acid dip, the parts are again rinsed and then plated. Especially before zinc plating, it is desirable to dip the work in a sodium cyanide solution from which the work is transferred directly to the plating bath without rinsing.

This cycle has been proven by long use prior to cadmium, zinc, copper and tin plate in a wide variety of applications to war production and gives remarkably trouble-free results.

For small parts which cannot be racked, the advantages of reverse current cleaning are being utilized through the use of special cleaning barrels which give a tumbling action as well as the electrolytic action. These barrels are so designed that it is possible to include them in the cleaning cycle of automatic bulk plating machines.

Another specialized application before plating which has large use is the cleaning of parts prior to barrel plating through the use of so-called "soak" cleaners. They are used to remove the oil and grease from metal parts prior to pickling, before annealing operations and most important of all before plating. Wherever possible, the parts to be cleaned should be tumbled or where this is not practical should be shaken at intervals. These cleaning compounds are especially designed to emulsify oils and greases and provide maximum possible oil emulsification to secure long life. In general, they are used at concentrations from 4 to 10 ounces per gallon at temperatures as near boiling as possible. Free rinsing is desirable as the nesting of the work makes rinsing difficult. While the use of this type of cleaner is old in the history of the art, there have been many improvements made. The modern immersion cleaners designed especially for this job and with more specific objectives than the early materials are deserving of being called modern cleaning compounds. The exact cycles which are used with these materials are extremely varied depending on the condition of the parts, the metal from which they are made and the equipment which can be made available. This type of cleaning is almost invariably used prior to parkerizing and the various black finishes. Each of these requires a material of different characteristics and recommendations for these types of finishes are different for each type of finish and may be still different for cleaning prior to plating.

For work which is to be painted, there are numerous methods of cleaning which depend on so many factors that it is impossible to enumerate them all. Cleaning for painting does not require the removal of scale and other inclusions so the use of acid pickles in the procedures is limited. One important method which has great practical utility and is one of the most highly standardized

of all cleaning methods is the use of degreasing solvents in a suitable machine. Trichlorethylene is almost universally used in this application because of the inherent advantages. Trichlorethylene is non-inflamable, boils slightly below the boiling point of water and its vapor is very heavy with a low heat of vaporization. Its boiling point is low enough that it may be vaporized by the use of heating with ordinary low pressure steam and the heavy vapor density and low heat of vaporization make it possible to maintain a sharp vapor line by the use of cooling with room temperature water. Removal of oil and grease but not inorganic dirts is rapidly accomplished and the final product is an oil free surface from which the trichlorethylene rapidly evaporates leaving a clean oil free surface which is good enough for painting and inspection. The whole process is fast, requires little floor space, is comparatively fool proof in operation and leaves a dry surface which has little tendency to rust. As a result of its special advantages, the use of degreasing machines using chlorinated solvents has increased rapidly.

To digress again from electroplating and anodizing, there is another important method of cleaning which possesses great indirect importance to the plater and with increasing production schedules is coming more and more favor for the operations prior to plating and anodizing. This method of cleaning is by the use of washing machines. Their application is limited only by the ingenuity of the engineer laying out the process cycle and the building of a machine to suit it. The chief disadvantage of these machines lies in their inflexibility. To change a cycle after washing machines have been installed requires a considerable loss of time and money to make the change. Small washing machines are available, however, which by proper layout can give the desired flexibility. In general, these machines are of two general types, the rotary drum type and the pressure spray washer. The first type consists of a rotating drum with a spiral partition which advances the parts through the machine as the drum rotates. The drum may be equipped with scoops to throw solution over the work on the inside of the drum or may be so constructed that the drum itself dips into the solution. Various combinations may be built up by a multiplicity of units giving almost any desired cycle of operations. The last stage may be a drying unit where clean dry work is desired. This type of

washer is suitable for small parts which will tumble and its action duplicates the action of a tumbling barrel using the so-called "soak" cleaner previously discussed.

The pressure spray washing machines are not widely used in plating and anodizing and their use is confined chiefly to intermediate operations. The principle of their operation is forcing a stream of the solution against the work. Streams of solution are directed at the work from various angles which must be carefully chosen. The work is usually moved through the spray on a conveyor either a monorail or web belt and in some cases both. The pressure may vary from a few pounds per square inch to 90-100 pounds per square inch. The force of this spray plus the detergency of the solution give efficient removal of inorganic dirt as well as oil and grease. Materials to be used must, of course, be non-foaming. Through proper choice of alkali aluminum, brass and steel may all be processed through the same machine. An outstanding feature of the pressure spray washer is the ability of the spray to clean in recesses where the sprays cannot hit directly. The stream appears to bounce and so strike recesses with considerable force. For the heaviest duty removal of greases, magnaflux dirt, carbonized quenching oils and lapping dirt hydrocarbon solvents are used as the cleaning solution. Additions may be made to this to increase detergency or provide good rust protection.

Because of the danger from fire as well as economic reasons new type solvent emulsion cleaners have been developed for these applications. These materials are used in a 1 to 3% by volume suspension in water. Their detergency is extremely high and is satisfactory for most of the jobs where solvent is used. Being neutral in character they may be used on any metal and will not stain or discolor it. The newest use of materials in pressure spray machines consists of a combination of a solvent emulsion material plus an alkali. In preliminary field tests, it has shown great promise of better results than either material alone.

The two metals which have grown greatest in importance since the start of this war are aluminum and magnesium. Their strategic importance is shown by the place at their top of the list of scarce metals. The hurried expansion of their production and use has brought more fundamental change than in the case

of any other metals. Similar as these two metals are in general physical characteristics, certain aspects of their chemical behavior differ so that no single procedure will suffice and it is necessary to treat each metal differently. Two basic cleaning problems arise in handling aluminum. The first of these is its preparation for anodizing and the second is its preparation for welding. The chemical reactions of aluminum which are of particular significance to the aluminum treater are its reaction with oxygen to form an adherent corrosion resistant coating and its solubility in highly alkaline solutions. The solubility in alkali is inhibited by silicates and accordingly alkaline detergents for the cleaning of aluminum are made with a controlled alkalinity and silicate content plus added emulsifiers and detergents. The attack on the aluminum is controlled to give as a rule only a very slight attack which helps remove carbonized oil. In some cases as in the production of frosted finishes, strong alkalies are used and the degree of etch controlled by carefully controlling the time of immersion. Strong alkali also attacks aluminum oxide and the cheapest method of stripping the anodized coating from racks and defective parts is by using a solution of a slightly inhibited alkali. The concentration of cleaners for aluminum is usually in the neighborhood of 4-6 ounces per gallon and the temperature from 180-200°F. Alkali solutions used for stripping anodized coatings are usually operated at a concentration of 4-8 ounces per gallon and a temperature of 180-210°F.

Another feature of note in the chemical reactions of aluminum is its resistance to oxidizing acids. Nitric acid has been used for a long time to remove the black smut from aluminum after treatment in alkali and recently addition agents have been marketed which give a clear white color to the aluminum. This may be used as an excellent strip for anodized racks and parts. A solution containing 40% by volume of nitric acid and 4 ounces per gallon of addition agent will strip anodized coatings in 3-5 minutes at room temperature leaving the surface clean and white. Other combinations of acids usually used at elevated temperatures are also used for this purpose with marked success.

Certain special methods of treating aluminum in bulk require cleaners which contain no silicate as this inhibits the action of the coating solution. For this purpose, special cleaning materials of very low alkalinity must therefore be used.

Spotwelding of aluminum has come into great use as a rapid economical method of joining parts. Its successful use depends on securing an oxide free surface. The method used in cleaning prior to spotwelding is in two parts. The first step is the removal of oil and grease. This is accomplished by the use of an alkaline cleaner such as those described for use prior to anodizing. After this cleaning, the parts are rinsed and proceed to the second step of the process. This is a treatment designed to remove any oxide film on the aluminum surface. A treatment such as the modified nitric acid is recommended. Here, too, various acid materials are available for this oxide removal. Several combinations of acids with chromic acid at total concentrations of about 10% and an elevated temperature are being used successfully. Many times where parts are free from oil, the acid treatment is the only treatment necessary. Although aluminum forms an oxide film as soon as it is exposed to the air, the film formed again following the acid treatment is very thin and uniform and causes no trouble in welding. It should be remembered that all the alloys of aluminum do not respond alike and procedures may have to be varied to compensate for special alloys.

Magnesium is as yet too new in the field of fabrication to provide any real challenge to cleaning methods. The outstanding difference between aluminum and magnesium so far as cleaning methods is the insolubility of magnesium in highly caustic solutions. The cleaning materials used on magnesium resemble those used on steel and the previously discussed "soak" cleaners are generally satisfactory. As progress is made in the field of magnesium fabrication the art of cleaning it will keep pace.

With the substitution of relatively abundant metals for the scarcer materials, many interesting problems have arisen which call for special cleaning materials. Special techniques have been worked out in many such cases.

Ferrous alloys have also received special attention and procedures for cleaning and pickling stainless steel and several other of the resistant alloys have been developed. Mention should also be made of the Bullard-Dunn process of electrolytic descaling. This process cleans and descales the work processed and deposits a thin film of tin over the entire surface. This tin is then easily removed if desired. The quality of the work which is descaled without dimensional change is responsible for its

steadily expanding use. Special applications of standard materials may be found in many special war production jobs. In all these special applications standard materials are generally used with special conditions and cycles to fit the specific job.

To summarize briefly, metal cleaning in war time has changed its emphasis but not its basic methods. Improvements are found in many of the methods with possibilities for futher improvement. With the increase in production beyond all previous goals and especially in view of the shortage of manpower automatic and semi-automatic cleaning machines of high capacity are being more and more widely used on a wider range of jobs. Special methods for these machines have been developed to fit the increased use. Treatment of aluminum and magnesium while fairly satisfactory should show improvement by the refinement of existing techniques and the development of new ones. Special materials and procedures are available for a large number of special conditions.

Taken as a whole, the art of metal cleaning under wartime conditions is progressing rapidly and many new and useful ideas are being developed.

MASTERS' ELECTRO-PLATING ASSOCIATION HOLD NOVEMBER MEETING

At the November meeting of the Masters' Electro-Plating Association held in New York City, the rate of operations among the members of the Association for the week ending November 7th was reported to be 62% compared with an average of 61½% for October and 84½% for October 1941. The operations of the members seem to be on an even keel at this time.

Members of the Association were asked to telephone the headquarters at 123 William Street, Barclay 7-9367 for information on rulings of the national and city governments. Some of the recent rulings concern reporting of copper and brass anodes, Certificates of Necessity for delivery trucks, Zinc restrictions, Sales Tax on Plating, Price Ceiling for Plating, and the labor situation.

Cadmium is critically short, it was reported, and the WPB finds it necessary to dole out the metal in small quantities and to refuse it for many purposes, recommending zinc instead.

Trade wants brought to the attention of the members were as follows: Men wanted for silversmith and repair; also polisher and sand bobber; also a plater experienced on silver hollowware. And a practical shop and engineering man to survey machinery for making critical war products. Salary $3800. Also inspectors of metal products and heavy machinery. Salary $3200. And a plater is available,—experienced production man.

The members pledged themselves to continue aiding the war bond drive and urged the adoption by the industry of the 10% pay roll savings plan.

Members of the Association were further urged to continue their efforts in the junk and scrap drive and to send in their Monthly Scrap Report regularly

Organic Finishing

By William Bruhns
President, Newark Branch

THE formulation of lacquers and the application of same has been practiced for a considerable period of time, for the purpose of metal finishing by various manufacturers of metal goods. The demand for these organic finishing materials has been increasing steadily over a period of years, because the protective value and the sales appeal of clear and pigmented lacquers when properly applied to metallic objects has long since been recognized as a valuable addition to a large number of finishes commonly employed by the manufacturer to enhance the value of his product.

In the earlier periods of the formulation of organic finishing materials, a number of natural resins such as CONGO, SHELLAC, KAURI, MANILA, DAMAR, PONTIANAC, etc. when mixed with Nitrocellulose solvent produced materials of varying degrees of quality. Some very high quality lacquers were undoubtedly formulated with these natural resins, however, the quality of these lacquers could not be consistently maintained due to the uncertain quality of the natural resins.

An old problem in the application of lacquers is the blushing of same, which at certain times of the year, particularly on hot and humid days presents a serious problem to the organic finishing executive. There are however various methods of overcoming this. Perhaps the simplest one from a physical point of view is to air condition the lacquer room. However this may not be economically possible in many instances, it is therefore necessary to find other means of overcoming this problem.

It is known that blushing is caused by solvents with a high evaporation rate. If the solvents evaporate too fast the temperature of the surface film will drop below the temperature of the atmosphere because fast drying solvents have a peculiar cooling effect on the surface film, this condition will cause humidity to condense, precipitating the moisture into the surface film on the work which in turn will cause either the solvent or

the resin to precipitate out of the film. It is therefore advisable to specify materials for use under such atmospheric conditions to contain a solvent with a low rate of evaporation, or to add a sufficient amount of retarder to reduce the rate of evaporation. These solvents or retarders which are used in Nitrocellulose lacquers will remain in the film until the temperature of the work and the atmospheric temperature have been equalized. In the use of clear lacquers the addition of a retarder often causes staining and other precautions such as air conditioning the lacquer room or raising the temperature of the work before or after lacquering may be necessary.

In the past fifteen or twenty years a considerable amount of interest has been shown in the development of synthetic resins. The efforts expended in this endeavor thus far, have met with definite success. Several high quality resins in which standardized specifications may be met and maintained at a constant value, have been developed. In addition to this they can be formulated to suit various specified finishing needs.

It is quite possible with these new resins to develop materials to resist alcohol, acid, alkali, heat and ultra violet. These materials may be obtained in various types such as low bake, slow drying, high bake, fast polymerizing and air drying lacquers. Heavier more resistant coats may be applied to the work at one spraying, due to the fact that a much higher percentage of a suitable synthetic resin in proportion to Nitrocellulose or other solvents may be used without increasing the viscosity of the material.

In formulating these synthetic resins for industrial application it is not very difficult to meet specifications, since aside from other desirable qualities, they are adaptable to a large range of viscosities.

The better known and most widely used of these synthetic resins are the UREA FORMALDEHYDE, PHENOL FORMALDEHYDE, and the ALKYD resin types.

Each of these having certain definite qualifications, which make them adaptable for various specified finishes for a variety of products. The UREA FORMALDEHYDE type of materials are particularly adaptable where low temperature baking for short periods is desired. It also has very good resistance to light, heat,

and water. The color retention of this material as well as the adhesion is excellent.

Where a good air dry material is desired, one may use the PHENOL FORMALDEHYDE type. This material has a good luster and is highly resistant to water.

The ALKYD type resin is preferred by many manufacturers because of its many qualifications. It has good adhesion, a high luster and retains its color under many adverse conditions. If it is formulated so as to contain a high resinous content, in proportion to its solvent content it retains its natural plasticity over a long period of time and when baked at a high temperature has good water resistance.

Synthetic materials are made for dip, spray and brush application. The dipping method is used on our compacts and cigarette cases with excellent results. The work is mounted on racks and submerged in the dip tank, the rack rests on a frame which rises with hydraulic pressure. The rate of rise is very slow so as to avoid the customary drip, that is usually present on dipped lacquer work, as much as possible. Another method is to mount the work, so as to have the drip in the least conspicuous place on the work. The better type of work is usually sprayed, since it is possible to apply a heavier coat on the work by the spraying method.

Up until a few years ago it was necessary to use a specially prepared Chrome primer for butler Chrome finishes in order to get good adhesion on the Chrome plated surface. Now, however, it is quite possible to coat a piece of Chrome plated work with a UREA FORMALDEHYDE base material which may be applied either by the dip or the spray method.

This procedure is the same one used on our butler brass and gold finished cases, we thereby eliminated entirely the special setup for Chrome work.

A material used for stopoff work for multicolored plated finishes has to have the ability to withstand numerous operations such as alkali cleaning, scratch brushing, coloring, etc. Very few materials obtainable for this particular type of work are entirely satisfactory, insofar as they do not possess all of the qualifications desired to produce a perfect three tone finish on a production basis. After experimenting for sometime with various materials obtainable for this type of work on the open market, my efforts

met with Varying degrees of success, however no material was found to produce the results desired without incurring a 15 to 20% rate of rejection, which of course increased the cost of manufacture on the case.

The procedure used on this stopoff work is outlined as follows: The stopoff lacquer is sprayed on the case through a stencil leaving only the portions of the case exposed which are to be plated. The work is then baked and allowed to cool, after baking it is usually found necessary to color the exposed portion of the case, because in spraying it, a fine mist is generally deposited on the metal at the paint line. After coloring, the work is racked, cleaned in a mild cleaner at a moderate temperature and plated with whatever metal is desired. For a second or third plating operation the same procedure is followed stripping the stopoff material after every plating operation.

In the course of experimentation I decided to try a synthetic material hoping that due to its superior quality it may have the qualifications desired to produce a perfect three tone finish without incurring a high rate of rejection. After a fair trial it proved to be the answer to this particular problem and the percentage of rejections was considerably lowered.

Many beautiful designs can be reproduced with enamels on a production basis, by employing stencils, specially cut for the designs. Reproductions of drawings may be made in this manner, to be as nearly perfect as the original. Various color tones and shadings can be affected, with this method. It may be necessary to use as many as thirty stencils on one design in order to get a perfect reproduction. This number of stencils can be considerably reduced, depending on the design and the details required for each particular design.

A number of different types of lacquers and enamels are necessary to produce the large variety of finishes that are called for on compacts and cigarette cases. Synthetic materials have been used by us for about five years, along with cellulose base materials. When this material was first recommended to us for our type of work it was necessary to make various tests to determine the advantages over other lacquers. The results of these tests were very favorable. The advantages are an improvement in appearance and the ability to withstand the common hazards of wear and the attack of various natural chemical compounds with which these cases come in daily contact.

The Fundamentals of Electrochemistry and Electrodeposition

XIV. The Deposition Potentials of Metals.

By SAMUEL GLASSTONE
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IT has been seen that if a metal, for example, copper, is placed in a solution of salt producing ions of the metal, namely cupric ions in this case, the metal will acquire a definite equilibrium potential; the value depends on the standard potential of the metal and the concentration of the ions in the solution. The importance of electrode potentials in connection with the displacement of one metal by another was considered in Part XIII (Monthly Review, November 1942); in the present article another aspect of electrode potentials of direct application to electroplating will be discussed.

The Deposition Potential: Reversible Electrodes

Suppose we have a solution of copper ions, such as one of copper sulfate, and we place in it two electrodes, to act as anode and cathode, respectively. The electrodes are then connected to a battery and a gradually increasing E. M. F. is applied until it is observed, from the appearance of the cathode, that the copper just commences to plate out. The potential of the cathode at this point is called the "deposition potential" of the metal, copper, separating from the solution. The important point to observe, now, is that if this deposition potential is measured it will be found to be almost identical with the equilibrium potential of the metallic copper in the particular solution employed. It is generally true for a number of metals, such as zinc, cadmium, copper, silver and mercury, and to a lesser degree for other metals, that in the electrolysis the metal will commence to deposit on a cathode when the potential is approximately equal to the equilibrium potential of the metal in the given solution. In

other words, for certain metals, which are said to behave in a "reversible" manner, the cathodic deposition potential is almost the same as the equilibrium potential of the metal in the solution used as electrolyte. As seen in previous articles, the equilibrium potential, at ordinary temperatures, is given by the equation

$$E=E_0+\frac{0.059}{z}\log C,$$

where E_0 is the standard potential of the metal, z is the valence of its ions in the solution, and C is the (ideal) concentration of these ions, expressed in terms of gram-ions per liter. Hence, for reversible electrodes, this equation gives also the deposition potential of the metal from the given solution. If we have, for example, a solution containing 5.62 grams of cadmium metal, in the form of a simply ionized salt, such as cadmium sulfate, in one liter of solution, the deposition potential can be calculated in the following manner. The atomic weight of cadmium is 112.4, and so the concentration of the solution is 5.62/112.4, i. e., 0.05 gram-ion per liter. The standard potential of cadmium is −0.40 volt, and hence the required deposition potential is

$$E=-0.40+\frac{0.059}{2}\log 0.05=-0.44 \text{ volt},$$

the valence of the cadmium ion being two. It follows, therefore, that before cadmium will commence to plate out from the solution under consideration, the potential of the cathode must be made equal to about −0.44 volt. It can be readily seen from the general equation that an increase in the concentration of cadmium ions will make the deposition potential more positive (i. e., less negative), while decreasing the concentration will cause the potential to become less positive (i. e., more negative).

Deposition from Solutions Containing Several Ions

So far it has been supposed that the solution contains ions of one type only: the question arises as to what happens if there are several ions present which are capable of producing metals by deposition on the cathode. The answer is that, in the absence of complicating factors, each ionic species will be discharged, and the metal deposited, in turn as the cathode reaches the appropriate potential. Let us consider, for purposes of illustration, a solution containing approximately molar quantities of cadmium

sulfate and zinc sulfate per liter, i. e., one gram-ion per liter of cadmium and zinc ions. The equilibrium potentials are, approximately, −0.40 and −0.76 volt, respectively, and the metal with the more positive (less negative) potential — that is, the cadmium — will be deposited first. By maintaining the cathode potentials at the appropriate value, in the vicinity of −0.40 volt, it is possible to deposit practically pure cadmium, in spite of the fact that the solution contains a considerable amount of zinc. If the electrolysis is prolonged, so that a large amount of cadmium plates out and is not replaced, the concentration of cadmium ions will be diminished and the potential, as noted above, will become more negative. Eventually the cathode may become sufficiently negative, namely −0.76 volt, for zinc deposition to commence; by the time this happens there will be almost no cadmium left in the solution. Another possibility, which will be considered more fully in another connection, is to pass a large current through the solution; it is then possible to make the cathode potential attain −0.76 volt even when the solution still contains appreciable quantities of cadmium ions. Under these conditions both metals, zinc and cadmium, will plate out simultaneously.

The general rules given in the previous paragraph also apply if the electrolyte contains more than two ions. The metal with the least negative (most positive) potential in the given solution will be deposited first, then the next in the series, and finally the one with the most negative potential. From a solution of copper, cadmium and zinc sulfates, for example, the metals will deposit in the following order: the copper first, then the cadmium, and finally the zinc. It may be mentioned here that the rule about metals plating out in the order of their equilibrium potentials is true even when the solution contains complex ions. However, it is important to remember that in such solutions the order of the potentials may not be the same as with solutions containing simple ions only. Various matters relating to the deposition of metals from solutions of complex ions will be considered in later articles.

Non-Reversible Electrodes

The foregoing discussion has been restricted to metals that behave in the so-called "reversible" manner, but a number of common metals, particularly nickel, iron and cobalt, do not

function as reversible electrodes. Various theories have been proposed to account for this behavior, but these are somewhat complicated and need not concern us here; the facts are, nevertheless, important and we must consider their significance. According to the table given in Part XII (October 1942), the standard potential of nickel is -0.23 volt, and so if nickel behaved reversibly it should commence to deposit on a cathode when the potential of the latter attained approximately this value in a molar solution of nickel sulfate or chloride. Actually, it has been observed that plating does not commence until a cathode potential of something like -0.4 to -0.5 volt is reached, at ordinary temperatures; this is approximately 0.2 to 0.3 volt more negative than the theoretical equilibrium value in the same electrolyte.

Polarization and Overvoltage

Any departure of an electrode from equilibrium conditions, no matter what the cause, is included under the general heading of "polarization." The particular type of polarization associated with the discharge of ions is called "overvoltage", and it is defined as the numerical difference between the actual deposition potential and the value to be expected for a reversible electrode in the same solution. It may be said, therefore, that the deposition of nickel from its simple salt solutions at ordinary temperatures is accompanied by an overvoltage of 0.2 to 0.3 volt. Somewhat similar overvoltages are associated with the discharge of iron (ferrous) and cobalt ions, to form metallic iron and cobalt respectively. These overvoltages decrease as the temperature is raised; at 75°C. the behavior of iron is almost the same as that of a reversible metal, the overvoltage being practically zero. With cobalt and nickel, however, it is necessary to go as high as 95°C. before the overvoltage of deposition disappears completely.

In order to allow for the overvoltage accompanying metal deposition it is necessary to modify the electrode potential equation If V is the overvoltage under a particular set of conditions, then the cathode potential (E) at which the metal begins to be deposited is now given by

$$E=E_0+\frac{0.059}{z}\log C-V,$$

where the symbols E_0, z and C have the same significance as before.

CHARLES HENRY PROCTOR DIES

FOUNDED A. E. S. in 1913

Charles Henry Proctor died December 3rd at the age of 76 at his home in Avon, N. J.

Mr. Proctor was born in Birmingham, England, and came to this country at the age of 15. He made his home in Arlington, N. J. where he lived for 42 years. Later Mr. Proctor lived seven years in Florida and more recently at Avon, N. J. Mr. Proctor was associated with the F. H. Lovell Co., at Arlington for a number of years and later with E. I. du Pont de Nemours Co., in the New York City office, up to his retirement ten years ago.

In 1913 Mr. Proctor founded the American Electroplaters' Society and became the first President. He served in this capacity for several years. He was a man of high ideals and unselfishly devoted to the advancement of the Society. The following excerpt from an editorial in the May 1923 issue of THE REVIEW serves to show the high ideals by which Mr. Proctor lived: "To the members of the American Electroplaters' Society, through this short editorial, I want to plead for more sunshine. Make AES a factor in your every day life. Let it shine and reflect your best efforts to make it the success it deserves, because after all it is your society. Let us plan from now on to make AES what it essentially is — the greatest practical educational society in the world."

"You must be up and doing
With a heart for any fate,
Still achieving, still pursuing,
Learn to labor and to wait."

Mrs. Proctor died a number of years ago and in her memory Mr. Proctor established the Hermine D. Proctor award. The $100 cash award is given each year to the author of the best paper read at the A.E.S. Convention.

Mr. Proctor is survived by two sons and a daughter, Harry R. and Edgar L. Proctor of Arlington, N. J. and Mrs. Osborne Preston of Nutley, N. J.

Supplies *and* War Production

By W. D. STARR
THE LEA MFG. COMPANY

The War Production Board has announced its new Controlled Materials Plan which is a system for connecting up the flow of scarce materials with production schedules. Seven claimant agencies, including not only divisions of the armed forces but also the Office of Civilian Supply, will set production schedules and allot materials accordingly. CMP will ease into effect during the first half of 1943, replacing the Production Requirements Plan.

For the present, the "Controlled Materials" consist of carbon steel, alloy steel, copper and aluminum. It is predicted that a careful control over these items will result automatically in satisfactory distribution of the less scarce metals and other materials. Including the three Controlled Materials there are at the present time nineteen materials all of which are called "CMP" materials. These include cadmium, nickel, and zinc. Any of the seven claimant agencies may request a prime contractor for a "Bill of Materials" listing required CMP materials. Sub-contractors may receive such requests from prime contractors. This form is made out only upon request. No one makes a move under CMP until requested to do so. After commencing under this plan, it's scheme of operation unfolds in a logical manner. The claim is made that under this system, allotted CMP materials are sure to be delivered because they will not be rationed beyond available supply or actual need. Less scarce materials are to remain under priority regulations similar to those now in effect.

Like anything new, CMP appears hard to grasp. Until it is actually in operation it is difficult to visualize it merely from a written description. However if it will eliminate some headaches we have been experiencing it certainly warrants close cooperation from those whom it will affect.

There is little news relating directly to plating materials. However it will be of interest that zinc cyanide is not currently on allocation even though it is scarce enough to require good preference ratings to effect satisfactory deliveries. Sodium Cyanide will be removed from allocation January 1 so that deliveries will then be subject only to priorities extended with purchase orders. Copper Cyanide remains on allocation. Orders for all Cyanides should be placed on or before the 10th of the month preceding the month in which delivery is wanted. This is important as transportation and many other factors are apt to delay delivery.

The Zinc Order, M-11-b, was amended on November 26 to further restrict the use of this metal in order to increase its availability for war products. Additional products of a civilian nature are listed under headings "A" and "A-1". Zinc plating is prohibited on all such listed items.

EMPLOYE PUBLICATION INTRODUCED

The Detroit Rex Products Company, manufacturers of Detrex degreasers, alkali washers, and chemical cleaning compounds, announces the publication of a new company newspaper, the DETREX NEWS. This monthly news magazine is mailed to employe's homes, to former employes now in the armed forces, and to all field men and branch offices. Employe activities in all departments are covered with interesting news slants and photographs. Important informative bulletins, such as gas rationing and tire conservation, are included. Designed to maintain the present high employe morale, "Detrex News" will gather the bulk of editorial material by means of employe reporters, established in the various plant departments and offices.

DR. WALTER R. MEYER TO DIRECT ENTHONE'S RESEARCH

Dr. Walter R. Meyer, on November 20, became technical Director of The Enthone Company, New Haven, Conn. He will direct the development of new products and processes for the metal finishing industry as well as

DR. WALTER R. MEYER

assist in problems attendant with the application of the company's products in the finishing of war goods.

Dr. Meyer has for the past four years been Editor of "Metal Finishing" and prior to that was affiliated with Sargent & Co. and the General Electric Co. He is Editor of four editions of "Plating and Finishing Guidebook." Dr. Meyer is a member of the A.E.S.

FORMATION OF THE CORROSION DIVISION

The Corrosion Division of The Electrochemical Society was organized at the Fall Convention of the Society in Detroit on October 9. This Division was formed because of the interest displayed by a large number of the Society's membership in this phase of the work. The object of the Division is to coordinate the interests of the Society relating to corrosion, with individuals and organizations which are particularly interested and active in this field, to solicit papers and plan symposia. Officers of the new Division are L. G. Vande Bogart, Crane Company, Chairman; H. H. Uhlig, General Electric Co., Vice-Chairman; and R. H. Brown, Aluminum Company of America, Secretary-Treasurer.

Business and Social News

BRANCH NEWS

Educational Activities

AMERICAN ELECTROPLATERS' SOCIETY

Grand Rapids Branch held its regular meeting October 9th in the English Room at the Rowe Hotel, there being approximately 30 members and attendance of several guests.

New officers for the year elected September 11th took the chairs and the meeting was conducted as follows. The minutes of the previous meeting were read and approved. Reports of committees given. A general discussion took place as to how to have more of the members attend the meetings during the following months. Several suggestions were made and filed.

Two new members' applications were received, voted upon and elected: Mr. Frank H. Joyce, Associate Member; Mr. Raymond Karczynski, Active Member.

Our speaker for the evening was then introduced: Mr. George W. Slomin, Chemical Consultant for E. H. Sargent and Company and the Allied Industrial Products who gave us an illustrated talk using slides, demonstrating instruments. His paper, "Overcoming Difficulties in Connection with Electrolytic Methods of Analysis and Methods of Inhibiting Undesirable Products in the Electrodes" was very well given. C. E. ABEL, *Secy.-Treas.*

"Grand Rapids Branch Annual Meeting Cancelled"

The Grand Rapids Branch will not hold its annual dinner dance and educational session this year. Local hotels and other buildings have leased their rooms to the Army School of Cadets which makes it necessary to cancel this event held each year.

C. E. ABEL, *Secy.*

Cleveland Branch. The monthly meeting of the Cleveland Branch was held on November 6th, with President William E. O'Berg in the chair.

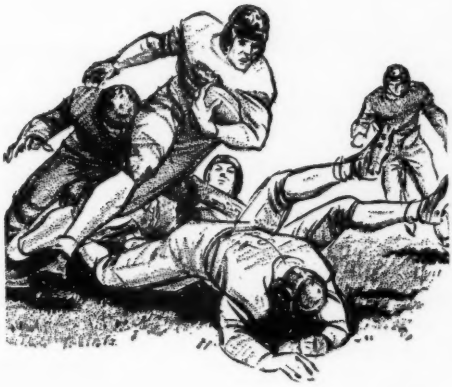
The minutes of the previous meeting were approved as read.

The application of Mr. Joe Lechner of Cleveland, as an Active member was read and referred to the Board of Managers.

There being no further business to be brought before the members, the meeting was turned over to our Librarian, John Honnecker, who introduced the speaker of the evening, Ernest Schweikher of the Grasselli Chemicals Department of the E. I. Du Pont de Nemours Company. Mr. Schweikher's subject was "Lead Plating." This he made very interesting by illustrating many of his points with a small lead plating plant set up before us.

The meeting adjourned at 10:30 P. M. after a rising vote of thanks to the speaker. GEORGE B. SVENSON, *Secy.*

Boston Branch. The Boston branch met on November 5th at the



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Minutes of the previous meeting were read and approved. Communications read and placed on file. Bills were read and ordered paid.

Three applications were read for the first time and turned over to the Board of Managers for approval. There being no further business the Chair was turned over to our Librarian, Lou. Gagnon, who introduced two speakers, Dr. Edward Engel and Charles Cahn of the Colonial Alloys Company of Philadelphia. One spoke of the work being done on aluminum such as plating and anodizing, and the other gave a demonstration of plating on aluminum and also anodizing different parts of aluminum. They answered many questions for the members, and a rising vote of thanks was given them for their interesting talks.

A. W. GARRETT, *Secy.*

Chicago Branch. The regular monthly meeting was held Friday, November 13, at the Atlantic Hotel, with President Savage presiding, and all other officers present.

A letter from the Detroit Branch inviting Chicago branch members to attend their educational session and banquet December 5th at the Statler Hotel was read and placed on file.

A letter from E. T. Candee, Acting Secretary, regarding the amendment presented at the Grand Rapids convention was read and a motion made and seconded that the Board of Managers send a letter to all the members of Chicago branch for suggestions and a vote on this matter.

Applications for membership were received and referred to committees. L. J. George of the Udylite Company was transferred from the Boston Branch to Chicago. Mr. E. G. Stenberg who has been a member of Chicago branch for the past 19 years has transferred to the Milwaukee branch, as he has moved to Milwaukee. Mr. Stenberg was a former secretary and also a past president of Chicago branch. All Chicago branch members wish you good luck in your new home, Ernie.

Mr. Mattcotti, Librarian, introduced the guest speaker, F. MacIntyre of the Cleveland Laboratory of the E. I. du Pont de Nemours & Co., who made a very interesting and instructive talk and demonstration of the "Hull Cell-Technique." The interest shown by the members in the demonstration of another tool to help the Plater control his solutions was so great that it was not possible to show the sound motion picture at this meeting. Both Mr. MacIntyre and the du Pont Company were given a vote of thanks by

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the entire Chicago branch members.

There were 110 in attendance and the meeting adjourned at 10:45 P. M.

J. W. HANLON, *Secy.*

Newark Branch. The regular monthly meeting of the Branch was held on Friday, October 2, at the Hotel Robert Treat, with President William Bruhns presiding. All other officers were present. The usual business and membership matters were passed upon.

Mr. Bruhns announced that a class for Electroplating and Chemical Analysis was being formed at the Essex County Vocational School, located at First Street and Sussex Avenue, Newark, with Paul A. Oldham as instructor, and that those interested should register by October 6th.

Horace Smith announced December 19th as the definite date for the Christmas Party.

William T. Maguire, Librarian, presented our old friend, Dave Clarin as the guest speaker of the evening. Dave's subject was "Faster Cleaners." Due to the present emergency and the speed-up in production it became necessary to develop faster cleaners, especially for steel and aluminum. Dave told us in detail how these problems were being conquered, and he was given a rising vote of thanks by the 47 members and visitors present.

Our Librarian started to conduct a "Question Box" when the siren sounded for a Black-Out. All was in darkness for a half-hour and the members had a jolly time telling stories and jokes.

GEORGE WAGNER, *Secy.*

The second meeting of the Newark branch in October was held on the 23rd, with President Bruhns presiding. Paul Oldham reported on the Christmas Party arrangements in the absence of our Chairman of Board of Managers,

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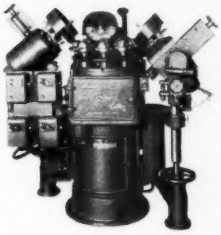

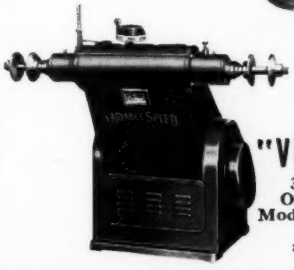

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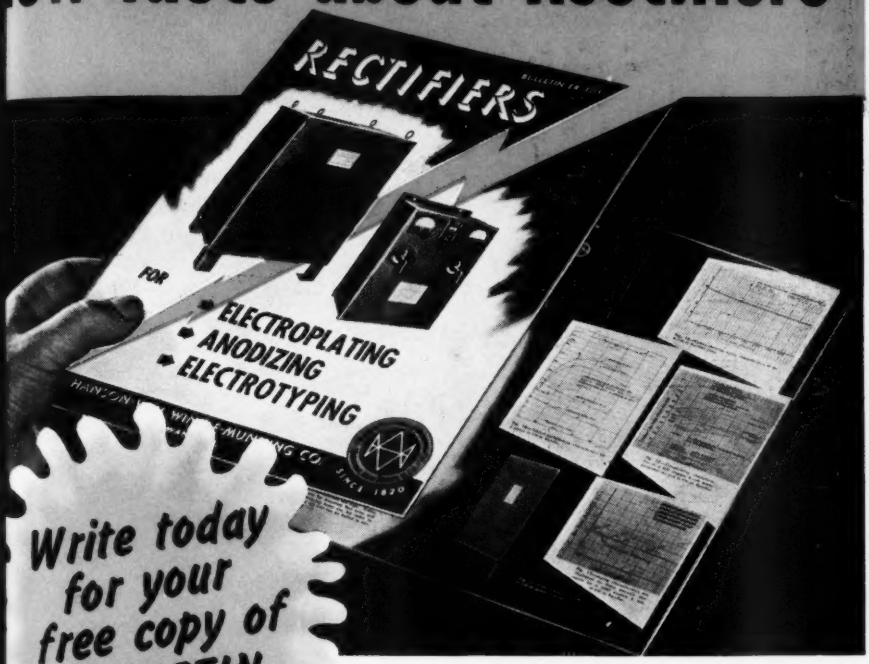

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Horace Smith, who had left to attend the Buffalo - Rochester - Toronto branches' joint meeting, with our Secretary, George Wagner and George Klink.

William Maguire, Librarian, explained that the subject scheduled for the evening had to be deferred to a later date due to the fact that the speaker had an urgent mission and no substitute was available. Mr. Maguire introduced Dr. Ernst of the Essex County Vocational System as a part of the program. Dr. Ernst spoke of the course in Electroplating at the Newark Schools and mentioned his disappointment in the poor registration. He appealed to the members to find a solution to the problem and after a lengthy discussion it was unanimously agreed that the course has outgrown its purpose and that a more advanced course be presented. The Educational Committee is to set up a more advanced course and present it to the proper State authorities. Dr. Ernst was given a rising vote of thanks for his contribution to our Branch.

An exciting and educational Question Box was next presented by our Librarian and Paul Oldham collaborated. The discussions were so long that it was decided to continue the questions at our next meeting.

JOHN B. KOTCHES, *Secy. Pro Tem.*

Hartford Branch. At a meeting of the Hartford Branch, held in the Hartford Electric Light Auditorium on October 19th, Mr. Fred Hartman was elected an Associate member. The Proceedings of the Annal Convention were distributed.

In addition to the guest speaker, R. J. Green of Alsop Engineering Company, who spoke on "Removal of Impurities from Plating Solutions by Filtering," the branch was fortunate in having a guest technical chairman, Wes Cassell of the Waterbury branch.

The subject was discussed from the management point of view as well as that of the platers. Mr. Green defined filtering as the mechanical separation of liquid from solids suspended in it, and said the wide range of filters now being used include charcoal, carbon, asbestos, and many others. He favored filter cakes of asbestos pulp which have long fibres that form an efficient mat, and pointed out that filter powders are not uniform in grain size and therefore the mass lacks uniformity when compressed under high pressures required for that type of filter.

Filtering under present conditions enables a company to increase production and get most out of equipment. It prevents bridging over impurities and keeps the cathode free from impurities. Filtered solution

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eliminates spotty or marred plating and results in fewer rejects.

Mr. Green expressed the opinion that the first cost should be charged to the operation of plating room as a whole. Best results are obtained where filters are placed on every tank and made a part of the cost of operating that particular solution.

Mr. Green contrasted the outmoded and modern methods and believes the new method improves the quality of the work and is much cheaper than the old method of decantation or siphoning. It is an investment that pays for itself in saving solution.

Mr. Green suggested a fairly coarse filter for the first operation in draining a 500 gallon tank. No wait is required for settling. A filter having a capacity of 250 gallons per hour will capably handle this job. One man can operate the filter and still have ample time to clean the anodes and bus bars. The suction hose should be adjusted to a point just below the surface of the solution. The solution is filtered into a spare tank or container then the original tank is cleaned and the solution is filtered back from the spare to the original tank with a finer filter. After the necessary additions have been made the solution is again ready for production. In all no more than 3 to 3½ hours should be required to filter a 500 gallon tank in this way.

Mr. Green ended his talk on the thought that it is not how much it costs to filter that should be considered, but how much it costs not to filter. A spirited question period followed and many additional points of interest were presented by members and guests.

J. H. DONAHUE, *Acting Secy.*

Detroit Branch. Detroit Branch held its November meeting Friday, November 6th at Hotel Statler.

President Fritts introduced Dr. Mulligan, of the Detroit Office of Civilian Defense, who spoke briefly suggesting that the members enroll in the Gas Officers' Institute. In his opinion, this is the best possible contribution that a chemically trained person can make to the Civilian Defense effort. We were glad to receive Dr. Mulligan's message, and no doubt many of the members will enroll in the Gas Officers' Institute.

The main feature of the evening was the presentation of "Bright Copper Plating in Acid Baths" by that well-known research team, William M. Phillips and Frank Clifton, of the General Motors Research Division. They have developed a copper plating bath which produces heavy coatings of copper having an amazing bright-

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ness. The preferred bath has a composition of copper sulphate — 210 grams per litre, sulphuric acid — 30 grams per litre, molasses — .80 grams per litre, thiourea — .04 grams per litre, temperature 70°F., current density 70 to 75 amperes per square foot.

At the close of the talk, Mr. Phillips and Mr. Clifton answered many questions and submitted samples of their bright copper plating which were comparable in every respect to modern bright nickel deposits.

All present felt that the real value of their contribution to our fund of plating knowledge would be better appreciated when peaceful manufacturing activities are again restored.

Plans were announced for our annual December party which met with the members' approval.

WRIGHT W. WILSON, *Acting Secy.-Treas.*

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Hartford Branch. The November meeting of the Hartford Branch was held at the Elk's Club in Bristol on Monday evening, November 16. Henry Strow of MacDermid, Inc., Waterbury, Conn., gave an exceptionally interesting and instructive talk on the use of bright zinc and zinc plating solutions as they applied to the present emergency program.

Mr. Strow pointed out that zinc is similar to cadmium in many respects. However, that at the present time, zinc is much more available. Of the many grades available only the two highest in purity are suitable for bright zinc plating where no purification of the solution is to be made at regular intervals.

It was pointed out that this subject is covered most thoroughly in the book, "Modern Electroplating," published by the Electro-Chemical Society.

It is interesting to note that zinc plating came into the picture once before due to a shortage of cadmium plate when the automobile manufacturers began to use large quantities of cadmium.

The subjects of metal content, cyanide Content, Caustic Soda and carbonate values were discussed in their relation to the operation of the bath. The content on metal of 3½ to 4½ is used for bright plate and from 4 to 5 for dull plate. Higher metal content is favored with higher current densities, lower metal content for better throwing power. The cyanide content varies with the metal and usually approaches a ratio of 2.2 or 2.5 tol. Caustic Soda seems to increase the cathode efficiency. Its ratio is also controlled to that of metal at about 2.2 or 2.5 to 1. Apparently carbonate is not as important as the

other factors and sometimes runs quite high in the bath.

Temperature is critical and should be kept below 85°C.

It was pointed out that the control for zinc is more careful than for cadmium plating and that the analysis on zinc plating solution is slightly more difficult than for cadmium plating. Its throwing and covering power is not considered as good as for cadmium plate and it requires a higher current density to plate. On the other hand, zinc is a lighter metal than cadmium therefore giving a thicker coating for the same weight metal. The final average for comparison on zinc to cadmium is usually a ratio of 5 to 3 in favor of cadmium.

It was noted that one must remove the zinc anodes from a plating solution to prevent the zinc content from creeping up. It was pointed out that a pure bright zinc resembles chromium or bright nickel in its lustre. A Nitric Acid dip of 1/6 to 1/2% is considered as good as can be obtained. The more common bright zinc bath has a sulphide brightener and if copper and lead are contaminants much brightener will be used up. Another way to remove these contaminants is with the use of zinc dust. One way to control the cyanide content of the bath is to use a pre-dip of fairly concentrated sodium cyanide before entering the plating bath. Zinc seems to give a better protective value than cadmium under all outside conditions other than marine and does not stand up as well as cadmium on salt spray tests.

K. P. BELLINGER, *Secy.*

Baltimore-Washington Branch. The November meeting of the Baltimore-Washington Branch was held November 7 at the Telford Buffeteria. 39 members and guests were present. The eleven candidates who had been presented at the October meeting were elected into membership, and applications of seven more prospective members were considered.

Plans for the Annual Banquet and Educational Session were discussed.

Dr. V. A. Lamb, Librarian, introduced the speaker of the evening, Myron B. Diggin, who is Chief Chemist of the Hanson-Van Winkle-Munning Co. He talked on "Zinc Plating in Relation to the War Effort."

The first part of Mr. Diggin's talk dealt with zinc and cadmium plating baths in general. The latter half of his talk was concerned with the zinc plating of malleable and grey iron castings, and contained much useful information. None of the usual procedures are effective for plating all specimens of malleable or grey cast iron. The mercury-zinc bath is not always successful in covering the castings. Striking the castings with cadmium or tin works well enough but these metals are not readily obtainable. The following procedure is suc-

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cessful with most castings. The castings are cleaned preferably by sand or shot blasting, but pickling with a sulfuric-hydrofluoric acid mixture may also be used. The castings should not be over-pickled. The castings are struck with zinc from a bright zinc cyanide bath which contains at least 5 oz./gal. of sodium carbonate. The current density is 125 amp./ft., which requires 8-9 volts. The castings may then be plated in an ordinary cyanied zinc bath, such as the following: zinc cyanide, 8 oz./gal.; sodium cyanide, 5 oz./gal.; caustic soda, 11 0z./gal.; sodium fluoride, ½ oz./gal.; gum atabic, 0.1 oz./gal.;--Temperature 100° F. In calculating current densities use 50 to 75 percent more current than corresponds to the apparent area, because of surface irregularities.

ABNER BRENNER, *Secy.*

Grand Rapids Branch. Grand Rapids Branch held its regular meeting November 13th at the Rowe Hotel which was attended by 30 members and a large number of visitors and friends.

The meeting was opened promptly at eight o'clock with a showing for forty-five minutes of moving picture reels entitled "A Fight from Egypt" and one other picture entitled "Ten Thousand Feet Deep," the former picture showing fighting in Africa and the latter the drilling for oil.

After the pictures, the meeting was then opened by our President, Homer Morton; all business transacted; reports of committees given. One application for membership was received and our speaker for the evening was then introduced. D. A. Jacobson, Combustion Engineer for the Burdette

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Electroplating & Metal Pickling

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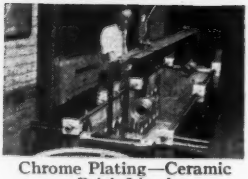
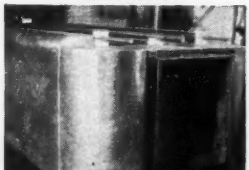


Chrome Plating—Ceramic Brick Lined



Anodic or Alumilite Tank Lead Fume Hood

TANKS
Plain or Lined with
Ceramic Brick - Carbon Brick - Plastic - Monel FLEX-A-PRENE - LEAD

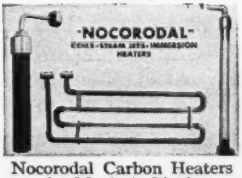
TANK HEATERS
Coils
Steam Jets
Gas Immersion
Nocorodal Carbon Heaters

ACID & ALKALI-PROOF MATERIALS

LEAD ANODES
HEIL SAWTOOTH

HEATING UNITS

Gas Immersion Unit Acid Dip



Nocorodal Carbon Heaters for Muriatic Pickle

HEIL ENGINEERING COMPANY
12901 Elmwood Avenue CLEVELAND, OHIO

Mfg. Co., talked on "Infra Red Ray Radiant Gas Equipment and Its Uses in War Production." He also demonstrated a gas unit which was mounted in display. Mimeographed copies describing the theory of Radiant Gas Heat was distributed.

Technical data books covering the Convention were distributed to members.

We then had the usual Question Box and Round Table discussion.

C. E. ABEL, *Secy.-Treas.*

QUESTION BOX
Grand Rapids Branch

1. *How would you dry barrel zinc plated small parts plated in a barrel and not produce stains?*

Ans. Either mechanical or air dried equipment is available. Parts are not to be heated. They can be blasted dry and then given a hot shot.

2. *Can you dry lacquer on wood with Infra Red Radiant heat?*

Ans. Yes! The procedure varies with different woods, but in general Infra Red heat can be employed.

3. *What type of cleaner and oxide removal compounds are necessary for oxide removal on aluminum alloys to be spot welded?*

Ans. 1. Abrasion
2. 2% Hydrofluoric acid
3. Oakite 84-A
   6-8 oz./gal.
   2-5 min.

Toronto Branch. The regular monthly meeting was held on November 13th at the Royal York Hotel, with President Boaz in the chair, and an attendance of 36, including Walter Barrows and George Ellis. Letters from Mr. Candee and Mr. Wagner were read. Three applications were received, one member was suspended, and the application of M. Novak was balloted on and he was received into membership.

Mr. Boaz brought up the subject of the annual banquet and dance, which will be held in March, for discussion and plan.

The three speakers of the evening were Bill Price, Allan Byers and Ewart Crighton. Mr. Crighton was unable to be present and his interesting paper was read by President Boaz, the subject being "Cadmium versus Zinc." Mr. Price's subject was "Bi Polar Electrodes", and he spoke from his every day experience, explaining in every detail of lined and steel tanks, anode hooks, insulated electrodes, distance from anodes to the work and throwing power, etc. "Hi Speed Bright Copper and Brass" was the subject of Allan Byers' talk, which he illustrated by showing samples all plated in barrels. These were made of steel and were parts of electric light lamps that screw into sockets. The samples were as good inside as out with a deposit of 2 mills. He explained in detail the routine from the Punch Press to the sawdust dryer. Many questions were asked and his 10 minute talk was lengthened to 30 minutes.

Copper Sol.

Copper Salt Gran.
Metal in Sol.—9 oz.
Caustic Potash—5 oz.
Heat—180°F.
Sq. foot—33 amps.
Wetting agent
Brightener
Filter

Brass Sol.

Scrap brass anodes
Copper—12 oz.
Zinc—4 oz.
Cyanide
Bi-carb.
P.H.—12 to 13

Heat—155°F.
Voltage—12

JAMES S. CAIRNS, *Secy.*

Philadelphia Branch. The Philadelphia Branch had its November "Social Nite" at the Broadwood Hotel, Saturday, November 21st.

With Vaudeville, Dancing, Supper and Beer, we had quite an enjoyable evening.

Among those present were Past Supreme President Fred Fulforth and Supreme Honary Member Phil Uhl, who is past 80 years of age.

Our next meeting will be December 11, 1942 (2nd Friday).

PAUL MENTZER, *Secy.*

Rochester Branch. The regular monthly meeting of the Rochester Branch was held Friday, November 20, at the Rochester Turners Hall with a delicious Fish Dinner served at 6:30.

The business meeting was called to order at 8:30 by the President John Adams. The minutes of the previous session were read and approved and the financial report was read. An application for membership for Raymond Snyder was presented and approved.

Mr. Lo Presti introduced Mr. Crane speaker of the evening. Mr. Berghold introduced Mr. Quigley, Mr. Couch and Mr. DeBishop to the members. Mr. Crane gave a very vivid description of burring modern warfare parts and products, describing the different types of wheels and abrasives used, such as, rolling, flexible tools with abrasive tips, felt wheels, expanding wheels, scratch brushes, and sewed and loose buffs.

The very interesting moving pictures of the Grand Rapids Convention were shown, through the courtesy of The Lea Manufacturing Company. The Rochester Branch wishes to express our sincere thanks to Mr. Crane and Mr. Couch of Lea Manufacturing.

DONALD C. BLUM, *Secy.-Treas.*

Bridgeport Branch. The regular meeting of the Bridgeport Branch was held November 6 at 8 P.M., at the Chamber of Commerce Rooms, Stratfield Hotel. President Charles McElroy opened the meeting with twenty-four members present.

The roll of officers was read and Sergeant-at-Arms, John Schneider, and Board of Managers, Wilbur Stratton and William Thompson were reported absent. The minutes of the previous meeting were read and accepted.

Arthur McNeil and C. C. Helmle will report at the next meeting regarding the purchase of a film projector. The Secretary and Treasurer issued a check for $250.00 in connection with this purchase and submitted it to Librarian C. C. Helmle.

Sick Committee reported that Bill Flaherty is doing fine and wished to hear from the members.

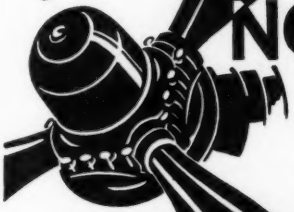
Membership Committee reports good progress is being made in securing new qualified members. A letter from 2nd Vice President M. R. Caldwell, suggesting means and ways to obtain new members was read, and the suggestions and information was so appealing, it was decided to bring up this program under the heading of Good of the Order.

A letter from George Wagner, Secretary of the Newark Branch, stating he had sent a package of year books of the Newark Branch, was read. These books were promptly given to the members and all were greatly pleased. The secretary wrote to George and the Newark Branch thanking them for these fine books.

Librarian C. C. Helmle gave a good

The DURABLE Black Finish for STEEL

For DEFENSE and NON-DEFENSE



This **attractive** and **protective BLACK** finish actually **penetrates** into the steel. Pentrate is specified on millions of defense items including steel propellor blades and hubs, other important aircraft and automotive parts, rifles, machine-guns, side arms, anti-aircraft parts, clothing hardware and many other items. The **simplicity** and **economy** of this low temperature process make it a natural for speeding up production lines.

Pentrate is **widely** used on gauges, bearings and precision instruments for **increased performance** and **protection.** Remember there is **positively no size change** and nothing to chip, crack, craze, peel or rub off.

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ATTRACTIVE BLACK APPEARANCE
NO SIZE CHANGE
ACTUAL PENETRATION
CORROSION RESISTANT
FRICTION REDUCING

Pentrate material shipped immediately from stock. No waiting — No priorities necessary.

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SPRINGFIELD, MASSACHUSETTS, U.S.A.

talk on how to have good and better meetings and Technical Sessions. It was pointed out that it is almost impossible to have good sessions with one meeting a month, therefore a motion was made and seconded to have two meetings a month, one with the business activities and round table discussions and another one with good speakers in Session. A Technical Committee was formed as follows: C. C. Helmle, R. J. O'Connor and A. R. McNeil.

A discussion was also had on the coming Convention Amendment proposal. It was agreed that this subject would be frequently discussed and will be brought up again at the next business meeting. This should be given a lot of thought as some members are for it and some to the contrary.

The Educational Session was in the form of Moving Pictures narrated by R. J. O'Connor and operated by A. R. McNeil and were enjoyed by all members present.

J. G. STERLING, *Secy.*

Lancaster Branch. The Lancaster Branch met at 8 P.M. November 13 at the Stevens Trade School.

The regular business meeting was dispensed with as our speaker wished to leave as early as possible.

The Librarian introduced Dr. C. A. Lankau who talked to us on "Protective Coatings in the War Industries." Dr. Lankau opened his talk by listing the fact that applications of coatings are dependent on shape of the object, the finish desired and the methods available.

The methods of applying coatings are dip, spray, roller coating, brushing, centrifuge and special methods. Shape is a very important factor in determining the method of application. Dr. Lankau listed various conditions necessary for good spraying, dipping, etc.

After the above remarks on the coatings in general Dr. Lankau listed the changes that have been made in various specifications of the Army and Navy to meet the requirements of a job with the materials that are available today. After answering several questions, Dr. Lankau closed his discussion by stating that if cooperation is had between the supplier, the manufacturer and the various government agencies a satisfactory solution to all coating problems can be reached.

At the business meeting the Chairman of the Library Committee reported that speakers were available for December and January meetings. It was decided to hold a Stag Social night in February, at a cost of $1.00

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per person. It was also decided to hold the March meeting in Harrisburg and the April meeting in York. H. Kilheffer and K. Nuss were appointed to take charge of the Harrisburg meeting and N. Gebert and D. Fleming of the York meeting.

The amendment to the Constitution to change the name of the Society was discussed at this meeting and it was decided to bring this matter before the Branch at our December meeting.

WILLIAM H. FORDNEY, *Secy.*

Waterbury Branch. Waterbury Branch held its regular meeting at the Hotel Elton on Friday, November 13th. The technical session was preceded by dinner, held in the Colonial Room at 6:30 P.M. At 8:00 P.M., Vice-President Carl A. Kilborn, opened the technical session in the absence of the President, with forty-five members and guests present.

The first presentation of the evening was a moving picture, "How to Rivet Aluminum," produced by the Department of the Interior. This film showed in detail various types and kinds of rivets used, principally in airplane manufacture, the methods of heat treating and their application.

Dr. George Dubpernell reviewed Dr. Glasstone's latest book entitled "Introduction to Electro-Chemistry." In his opinion, this is a very excellent book on the subject, but is hardly suitable for electroplaters, being intended more as an introductory text for college students.

Earle Couch announced that at the December meeting Kenneth Hawthorne, of Seth Thomas Clock Company, will talk on "Testing of Lacquered Coatings." Mr. Hawthorne's talk will be supplemented by a film, "Hidden Gold," supplied by the du Pont Company, on spray lacquer. (Since this meeting, we have learned regretfully of Mr. Hawthorne's sudden death).

A new monthly feature, "Priorities as They Affect Metal Finishing," is conducted by W. D. Starr. In his opening remarks, Bill suggested that the pamphlet, "Victory," issued by the O. P. M., is extremely valuable to anyone having to procure supplies as it contains the latest information on procurement of materials and its cost is only seventy-five cents per year. Obtaining scarce materials requires a lot of time and thought on the part of the plater, while other materials such as cyanides, anodes, nitric acid, etc., while not unavailable require considerable time to obtain. Now in December, we should think of and order our January requirements. Zinc is fairly easy to obtain but it is on allocation, and orders should be placed prior to December 10th for January delivery.

Richard Crane, as technical chairman, introduced Myron B. Diggin, chief chemist of the Hanson-Van Winkle-Munning Company. Mr. Diggin's subject was zinc plating in relation to the war effort. Comparing zinc and cadmium, he showed that zinc has greater resistance to corrosion than equal thicknesses of cadmium, that the zinc cyanide solution is more difficult to operate than cadmium and zinc solutions, particularly bright-zinc solutions are much less tolerant to impurities. Metallic impurities in particular are especially detrimental, destroying the luster of zinc deposits. The effect of as little as .006% copper is apparent. He detailed completely the preparation prior to plating, the actual plating, the treatment necessary to prevent staining of the plated coating, and the composition and maintenance

MAGNUS ELECTREX CLEANERS
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AUTOMATICALLY—
Today's Efficient Method of Volume Finishing
AUTOMATIC POLISHING & BUFFING MACHINES
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THE PACKER MACHINE CO., MERIDEN, CONN., U. S. A.

REMOVE COPPER PLATING
with
McKeon's
"Liquid Sulphur"
Sample — FREE
SULPHUR PRODUCTS CO. GREENSBURG, PA.

of both, white and bright solutions.

Of particular value was the information obtained from experiments conducted on the plating of malleable iron and gray iron castings. The method worked out gave 100% perfect results, and consisted of striking the pieces at a current density of 125 amperes per square foot, in the usual cyanide solution containing at least 5 ozs. per gallon of sodium carbonate. It was found that addition agents used for bright plating, aided materially in covering. As there are many malleable castings to be plated, this work should be of immense value.

For all of us who have to cope with plating increased amounts of zinc, Mr. Diggin's talk was most helpful. From the questions asked and the comments heard, it was thoroughly appreciated.

SPENCER L. HENN, *Secy.*

Cincinnati Branch. The Cincinnati Branch held its monthly meeting at the Hotel Gibson on November 19th. President Miesner opened the meeting with our usual good attendance. A. E. Alfspring of the American Walkers Association gave a talk illustrated with motion pictures of the Smoky Mountains and Natural Bridge. Mr. Stoddard, our ace in the hole when we do not have a technical speaker, demonstrated a device of his for testing thickness of Plating, which was very interesting. A variety of metal finishes on name plates, badges, etc. made by Fox Company, were on display. Someone found Bill Elbone and Tom McHugh and brought them. We hope to have a meeting in December, but gas rationing will cut our attendance as some members come from out of town.

We have had many very interesting meetings this year and are well on our way to a good increase in attendance.

We also wish to thank the Newark Branch for their very fine books.

AL FOREMAN, *Secy.*

The officers of the Supreme Society extend the best wishes of the Season to our Members, Advertisers and Subscribers to the Monthly Review.

May each of you enjoy a Merry Christmas and look forward to a bright and prosperous New Year.

The Executive Board
Charles C. Conley
George J. Wagner
Maurice R. Caldwell
Clarence C. Helmle
Ellsworth T. Candee

Facts about Metal Polishing

mportance of Correct Drying of a Glue-bonded Polishing Wheel

Animal hide glue has the property of taking on or giving off moisture, depending on prevailing weather or on the relative humidity in the dry room. Since hide glue reaches its maximum strength when it contains 10% to 12% moisture, the wheels should, therefore, be dried until the glue has this moisture content. This means that the dry room should be regulated not only for temperature but also as far as possible for relative humidity. Ideal drying conditions are 85°F. and 50% relative humidity. If these conditions are maintained with reasonable accuracy, most one-coat polishing wheels can be dried within 24 hours and two-coat wheels within 48 hours.

Drying time is dependent on the thickness of the wheel head; the thicker the head the longer the drying time. The strength of the glue, the abrasive grain size, and the number of coats determine the thickness of the head. For instance, a wheel set up with coarse grain requires a heavier glue solution than one set up with fine grain. For the same number of coats the head is thicker with the coarser grain, requiring a longer drying time.

A practical test to find out when a wheel head is dry enough is to hit it with a round steel bar and observe the readiness with which i cracks.

NORTON COMPANY, Worcester, Mas

G-145

NORTON ABRASIVES

The Abstract Section

GEORGE WAGNER, *Chairman, Program and Educational Committee*

Effect of Trivalent Chromium on the Kinetics of Chromium Plating. By N. D. BIRYUKOV, S. P. MAKAR'EVA and N. D. PODOBED. *Korroziya i Borba s Nei* **6,** No. 2 10-14 (1940). *Chemical Abstracts* **36,** 3733 (1942). Trivalent chromium added as $Cr(OH)_3$ reduces the evolution of hydrogen and decreases the cathode efficiency; and oxidation at the anode is 4-5 times as fast as of CrIII obtained by cathodic reduction of CrO_3. CrIII from Cathodic reduction increases hydrogen evolution, but increases the cathode efficiency up to a certain point, then further CrIII reduces it.

ERNEST H. LYONS, JR.

Insoluble Anodes in Plating Baths. By W. ECKARDT. *Zetall-u. Schmuck.-Farbik. sowie Verchrom.* **21,** No. 2, 52-3 (1940); *Chem. zentr.* **1940, I,** 2851. Lead or a light metal is recommended as insoluble anode in Ni-plating baths. The baths should be free of halogens. Anodes of platinum or nickel are best suited for Ag-plating baths. The cyanogen formed at these anodes during electrolysis must be fixed by the addition of sufficient AgCN.

M. G. MOORE, *Chemical Abstracts.*

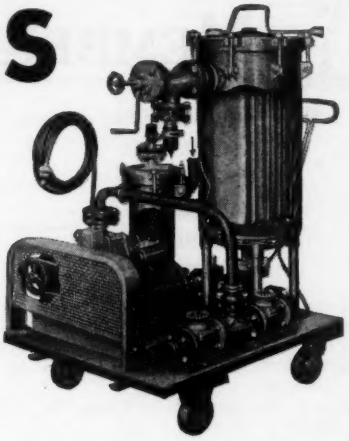
The Method of Gold-Plating the Star of the Soviet Pavilion at the New York World's Fair. By N. T. KUDRYAVTSEV and collaborators. *Korroziya i Borba s Nei* **6,** No. 2, 46-7 (1940). In gold plating stars and clocks at the Kremlin towers, various stop-off coatings decomposed in the cyanide bath and produced defective deposits. The following procedure was therefore adopted: (1) Fine polishing of the side to be plated, (2) washing in benzine, brushing with hair-bristled brushed wetted in benzine, wiping with cotton flannel cloth, (3) degreasing with a paste of Vienna lime, (4) chem. etching in 3% KCN sol'n., (5) amalgamation in a soln. containing $Hg(CN)_2$ and KCN (5 and 10 g./1., resp.), (6) silver plating in a soln. containing Ag 15-30 and KCN (free) 20-40 g./1. The cathode c.d. was 2 amp./sq. ft. at 68° F. The film obtained was .002-.003″ thick. The silver plating was in 3 stages: (*a*) .0003-.0004″; (*b*) .0012-.0014″; (*c*) .0004-0008″. After each stage the plated article was dipped into a 0.5% soln, of tartaric acid, then scratch-brushed and gradually heated in an oven at from 140° to 240°F. during 3-5 hrs. Just before the next stage of Ag-plating the article was rubbed with a semi-fluid chalk paste and then rubbed with a 3% Na_2CO_3 soln. The gold plating was done in a soln. containing Au 3-5 g./1. and KCN (total) 12-20 g./1; c.d., 0.5-1.5 amp./sq. ft. at 140°F. The thickness of the gold film was .001-.0016″. The process of gold plating was interrupted three times in order to scratch-brush the surface of the film. The piece was immersed in 0.5% tartaric acid soln. and treated as in the silver plating, except that heating in the oven was done at 176-213.4°F. The gold plate was finally buffed and then given 2 coats of lacquer, baked on.

C. S. SHAPIRO. *Chem. Abstracts.*

FILTERS

For

Bright Nickel
Nickel
Chrome
Copper Sulphate
Cyanide Copper
Brass and Zinc
Cadmium
High Speed Copper
Brite Zinc
Silver
Electrocolor
And Others



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The "LEAK-PROOF", "CORROSION-PROOF" and non-contaminating construction of Industrial Filters is a vital requisite of Electroplating filters.

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MEMBERSHIP REPORT

MAURICE R. CALDWELL, *Chairman, Membership Committee*

To December 1, 1942

ELECTIONS

Baltimore-Washington Branch

James Edward Boback, 2305 3rd St., N.E., Washington, D. C., U. S. Navy, Associate
John J. Bognar, 1212 Talbert St., S.E., Washington, D. C. (War Production Board), Active
Hiram Farrell, 1111 10th St., S.E., Washington, D. C. (Washington Navy Yard), Associate
Clifford Eli Holden, 112 Chinquapin Village, Alexandria, Virginia, U. S. Navy, Active
Howard E. Leannarda, Jr., 179 35th St., N.E., Washington, D. C. (Washington Navy Yard), Associate
Waring G. Myers, 407 B St., N. E., Washington, D. C., (Washington Navy Yard), Associate
Leroy R. Platt, 7700 Takoma Avenue, Takoma Park, Md., (Air-Track Mfg. Corp.), Associate
Curtis K. Smoyer, 405 9th St., N.E., Washington, D. C. (United States Government), Associate
C. H. Singstack, 3rd., 35 Seaton Pl., N.W., Washington, D. C. (Washington Navy Yard), Associate
Lloyd Acton Taylor, 1606 Vee St., S.E., Washington, D. C., (Washington Navy Yard), Associate
D. F. Wood, 2605 30th St., N. E., Washington, D. C., (Washington Navy Yard), Associate

Chicago Branch

F. A. Rudman, 3001 Engelke St., Houston, Texas, Associate
M. Brenan, 11206 S. Vernon Ave., Chicago, Ill., Associate

Grand Rapids Branch

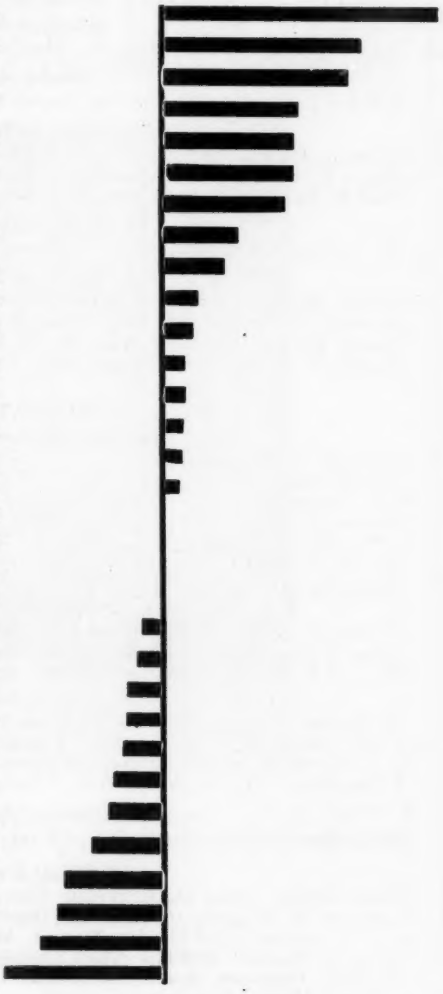
Raymond Karczynski, 90 Scribner Ave., N.W., Grand Rapids Mich., (Grand Rapids Brass Co.), Active
Frank H. Joyce, 355 Winter St., Grand Rapids, Mich., (Mfgrs. Hard Chrome Plating Co.), Associate

Detroit Branch

Clarence G. Chambers, Wayne Div. Bendix Aviation Corp., Wayne, Mich., Active
George A. Pillsbury, 1104 Nottingham Road, Grosse Pointe Park, Mich., Associate
Adam J. Seibert, Jr., 4228 Arlington Dr., Royal Oak, Mich., Associate
Ralph A. McDonald, 1003 Hutchins Ave., Ann Arbor, Mich., Active
Wilbur C. Thiess, 16543 Five Point Rd., Redford Twp., Detroit, Mich., Associate

MEMBERSHIP CAMPAIGN REPORT

BRANCH	May 1, 1942	Change in Membership	Percent Change
Cleveland	81	+14	+17.3
Indianapolis	48	+6	+12.5
Balt.-Washington	82	+9½	+11.6
Newark	156	+13	+ 8.5
Cincinnati	42	+3½	+ 8.3
Syracuse	31	+2½	+ 8.1
Pittsburgh	52	+4	+ 7.7
Waterbury	97	+4½	+ 4.6
Rochester	80	+3	+3.8
San Francisco	46	+1	+ 2.2
Buffalo	55	+1	+ 1.8
Bridgeport	80	+1	+1.25
Chicago	258	+3	+ 1.2
Philadelphia	142	+½	+ 1.1
Toronto	87	+1	+ 1.1
Los Angeles	128	+1	+ .8
Binghamton	16	0	0
Detroit	277	0	0
Prov.-Attleboro	49	0	0
St. Louis	82	0	0
New Haven	105	—1½	— 1.4
Milwaukee	97	—2	— 2.1
Springfield	72	—1½	— 2.1
Lancaster	44	—1	— 2.3
Grand Rapids	87	—2	— 2.3
New York	139	—4½	— 3.2
Boston	118	—4	— 3.4
Hartford	67	—3	— 4.5
Montreal	44	—2½	— 5.7
Dayton	99	—6	— 6.1
Anderson	38	—3	— 7.9
Toledo	46	—10	—21.8



NOTE: Honorary members are included with each Branch.

MEMBERSHIP — May 1st, 1942 = 2845
MEMBERSHIP — Dec. 1st, 1942 = 2875
GAIN IN MEMBERSHIP 30
GAIN = 1.06%

Hartford Branch

Fred Hartman, 85 South Broad St., Meriden, Conn. Associate

Montreal Branch

Ernest Alton Lunn, 7087 De L'Epee Ave., Park Extension, Montreal, Canada, (Warren Industries, Ltd.), Associate

Lancaster Branch

Arthur J. Connor, 1826 Holly St., Harrisburg, Pa. Associate

Newark Branch

Edward J. Novak, 212 First St., Jersey City, N. J., Active

Rochester Branch

Henry J. Burns, 106 Iceland Park, Rochester, N. Y., Active
Albert E. Drews, 25 Rockland Park, Rochester, N. Y., Associate
Paul H. Johnson, 1390 Monroe Ave., Rochester, N. Y.

Toronto Branch

M. Novak, 476 Richmond St., Toronto, Ont., Associate

Waterbury Branch

Everett M. Patterson, c/o Waterbury Clock Co., Waterbury, Conn., Associate
Domenic V. Pavone, 860 Frost Road, Waterbury, Conn., Active
Joseph Butkus, 334 South Main St., Naugatuck, Conn., Active
Charles F. Healey, 169 Buckingham St., Waterbury, Conn., Associate

APPLICATIONS

Baltimore-Washington Branch

Durward C. Partlow
L. J. Felton
L. J. Eckenrode
Warren J. Hays
D. Luther Hiltibridle
Orlando T. Kott
David Davis

Boston Branch

William E. Dailey, 72 Sycamore Ave., Brockton, Mass., Active
James J. Grossbard, 23 Claflin Road, Brookline, Mass., Active
Howard R. Range, 17 Hartwell Street, Waltham, Mass., Active

Chicago Branch

D. English, 1553 N. 39th Ave., Melrose Park, Ill., Active
J. M. Grills, 1509 S. Kildare Ave., Chicago, Ill., Active
A. F. Cardenas, 3618 N. Sacramento Ave., Chicago, Ill., Active
J. Hargraves, 4446 N. Austin Ave., Chicago, Ill., Active

Cleveland Branch

Joe Lechner, 9706 Steinway Ave., Cleveland, Ohio, Active

Detroit Branch

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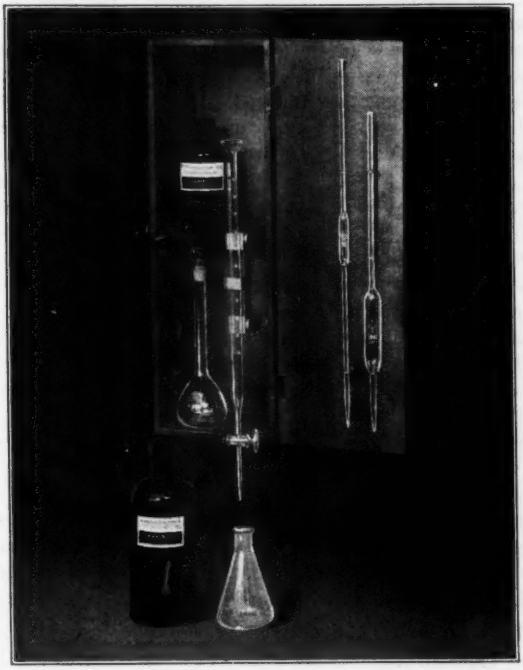

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Please mention THE MONTHLY REVIEW *when writing*

High-Speed Analysis and Control of Plating Solutions. By GEORGE JERNSTEDT. *Trans. Electrochem. Soc.* **82,** (Preprint 17) (1942). There is need for rapid methods of analysis of plating baths, especially where many different baths are operated in relatively small tanks. If analysis is not rapid, the bath may change before analysis is completed and make control more difficult. Rapid analysis affords closer control, more uniform results, and lowers the costs of analysis and of bath maintenance.

In using a centrifuge, a sample of the plating bath is pipetted into a centrifuge tube, and appropriate reagents are added. The tube is spun in the centrifuge for 5-10 minutes and the analysis is read directly from the height of the precipitate on the scale on the tube. Several analyses may be performed at one time. Directions are given for determining carbonate in high-speed copper baths by precipitation with barium chloride; 4 determinations may be made in 30 minutes, and the accuracy is 3%. Free cyanide is determined similarly, using a copper sulfate addition, with an accuracy of 1%. Copper, tin, and other metals may be determined in the centrifuge, but generally the electrolytic methods are preferred; gold, nickel, copper, zinc, and alloy baths are analyzed efficiently, and the operator is free for other work during the electrodepositions.

In using a spectrophotometer, a sample of the plating bath is placed in the cell of the instrument, and in some cases a reagent is added. A reading is taken and referred to a standardization chart, from which the analysis is read directly. This very rapid method has been applied to nickel; applications to boric acid, copper, and total cyanide are under development. The spectrograph is less useful.

The double damped projection type balance affords accurate weighings in less than one minute, while the standard analytical balance requires about five minutes. Automatic pipettes also save time. Reports of analyses should be standardized, and suggested forms and control sheets are given. Routine calculations are simplified by a special slide rule, drawings of which are given; it saves time and reduces errors. By these methods, very substantial savings in time have been accomplished. In trouble-shooting, a bath may be analyzed in a few minutes. ERNEST H. LYONS, JR.

Studies on Overvoltage. XIII and XIV. By A. L. FERGUSON and MYRON B. TOWNS. *Trans. Electrochem. Soc.* **82,** (Preprints 25 and 26) (1942). Overvoltages are doubtless of great significance in electroplating, although our present understanding does not give a very clear picture of the mechanism of either plating or overvoltage. These papers are of interest to platers as the most recent work on overvoltage, and appear to achieve an acceptable explanation of hydrogen overvoltage at a platinized platinum cathode, and to challenge previous theories on overvoltage. It is found that the potential is influenced by conditions on the *solution* side of the double layer at the cathode. The diffusion of hydrogen away from the cathode appears to be of primary importance, apparently by affecting the activity of the hydrogen atoms and hydrogen ions at the interface. Similar processes doubtless apply to many plating problems, and we may hope that further progress in such studies may eventually yield results of value to the plater.

ERNEST H. LYONS, JR.

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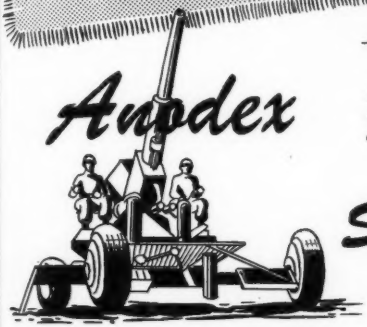

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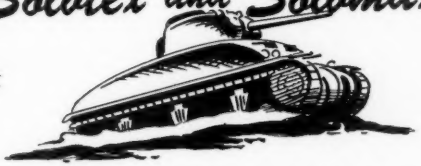

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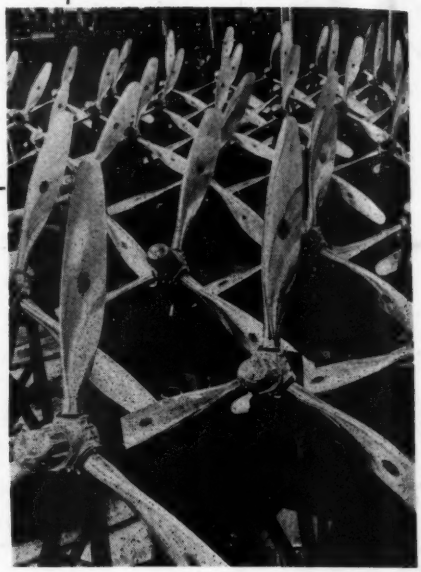

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